

A temperature of a reaction is adjusted to 300 degrees Celsius agitating the Cd-OA complex solution the Zn-OA complex solution.

After the reaction is finished, a temperature of the reacted mixture is reduced to a room temperature as soon as possible, then an ethanol of a non-solvent is added and a centrifugation is performed. A supernatant of a solution, except for a precipitation, centrifuged is thrown away, and the precipitation is dispersed in toluene to synthesize a nanocrystal solution of Zn_xCd alloy emitting light of 459 nm.

Then, the synthesized nanocrystal solution of Zn_xCd alloy is added into the reactant, then a S-OA complex solution is slowly added and a reaction is performed at 270 degrees Celsius for one hour.

Then, after the reaction is finished, a temperature of the reacted mixture is reduced to a room temperature as soon as possible, then an ethanol of a non-solvent is added and a centrifugation is performed. A supernatant of a solution, except for a precipitation, centrifuged is thrown away, and the precipitation is dispersed in toluene to synthesize a nanocrystal solution of $Zn_xCd_{1-x}S$ alloy emitting light of 459 nm.

Separately, zinc sulfate and dodecylamine are dried at 80 degrees Celsius for one hour, and then agitated for three hours.

Then, sulfur in power state is injected, then agitation is performed for 10 minutes, and then agitation is performed in autoclave at a reaction temperature of 200 degrees Celsius for one and a half hours.

Then, a HX (X=F, Cl, Br, or I) gas is injected, and then a centrifugation is performed. A supernatant of a solution, except for a precipitation, centrifuged is thrown away, and the precipitation is dispersed in toluene, then ZnS nanocrystal is grown on a surface of the $Zn_xCd_{1-x}S$ alloy nanocrystal to synthesize a quantum rod of core/shell structure of $Zn_xCd_{1-x}S/ZnS$.

A band gap of the quantum rod having the core of the mixed semiconductor particles and the shell of one of the mixed semiconductor particles is shown in FIG. 6.

In this embodiment, a difference of band gap between the core **210** of the mixed CdS and ZnS and the shell **220** of ZnS can be about 0.5 eV, thus the difference of band gap between the core **210** and the shell **220** can be reduced. Accordingly, the electron and hole directly relevant to illumination of the quantum rod **200** can stably exist, and thus high efficient illumination, high clear illumination and high chemical stability can be achieved.

A light emitting spectrum of the quantum rod of this embodiment is shown in FIG. 7. Referring to FIG. 7, it is shown that the quantum rod having the core of the mixed CdS and ZnS and the shell of ZnS can emit blue light of wavelength of 450 nm to 480 nm.

As described above, the core **210** is formed in alloy type by mixing at least two materials of different band gaps, and the shell **220** is formed of one having a higher band gap out of the materials forming the core **210**, and thus high efficient illumination can be achieved.

Accordingly, the quantum rod of this embodiment can be applied to various light emitting elements by utilizing the quantum rod for a light emitting layer.

Particularly, the quantum rod is useful for forming an organic thin film of a light emitting diode, and more particularly, for forming a light emitting layer.

When the quantum rod is applied to the light emitting diode, a vacuum deposition method, a sputtering method, a printing method, a coating method, an inkjet method, or a method using electron beam.

The organic thin film may be referred to as a film made of organic material, which is formed between a pair of electrodes of the organic light emitting diode, such as the light emitting layer, an electron transporting layer, a hole transporting layer, or the like.

The organic light emitting diode may be formed, but not required, to have a usual structure of anode/light emitting layer/cathode, anode/buffer layer/light emitting layer/cathode, anode/hole transporting layer/light emitting layer/cathode, anode/buffer layer/hole transporting layer/light emitting layer/cathode, anode/buffer layer/hole transporting layer/light emitting layer/electron transporting layer/cathode, anode/buffer layer/hole transporting layer/light emitting layer/hole blocking layer/cathode, or the like.

The buffer layer may be formed of a material usually used, and preferably, but not limited to, copper phthalocyanine, polythiophene, polyaniline, polyacetylene, polypyrrole, polyphenylene vinylene, or derivative of one of them.

The hole transporting layer may be formed of a material usually used, and preferably, but not limited to, polytriphenylamine.

The electron transporting layer may be formed of a material usually used, and preferably, but not limited to, polyoxadiazole.

The hole blocking layer may be formed of a material usually used, and preferably, but not limited to, LiF, BaF_2 or MgF_2 .

As described above, in the embodiment, the quantum rod includes the core of the mixture of two semiconductor particles, and the shell of one having a higher band gap out of the two semiconductor particles, and thus the difference of band gap between the core and the shell can be reduced. Accordingly, the electron and hole directly relevant to illumination of the quantum rod **200** can stably exist, and thus high efficient illumination, high clear illumination and high chemical stability can be achieved.

Moreover, the core is made of the mixed CdS and ZnS and the shell is made of ZnS, and thus blue light of wavelength of 450 nm to 480 nm can be emitted.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A method of fabricating a quantum rod comprising: forming a core nanocrystal using semiconductor particle; doping a surface of the core nanocrystal with a transition metal; and growing the core nanocrystal into rod shape, wherein the grown core nanocrystal is doped with the transition metal only at one of longitudinal ends of the grown core nanocrystal, and the other one of the longitudinal ends of the grown core nanocrystal is not doped with any other chemical element, wherein the grown core nanocrystal is made of a chemical compound including Zn and the transition metal is a metal selected from a group consisting of Cu^{2+} , Tb^{3+} and Mn^{2+} , the transition metal has a weight % of about